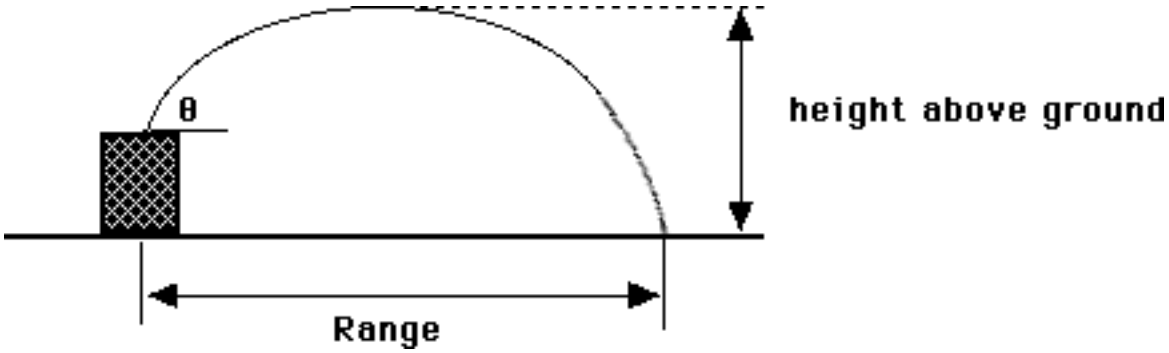
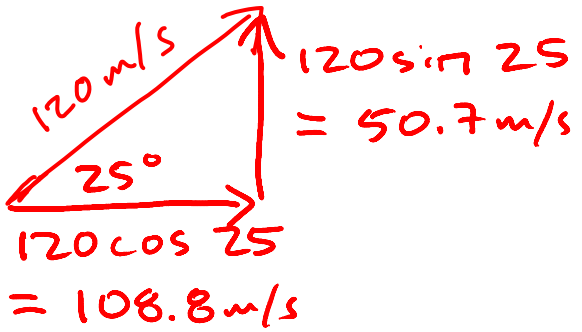
Example 6.
The case of a projectile launched at an angle to the horizontal from a point above the ground.



In this example the mass is shot at 25° above the horizontal at a velocity of 120 m/s from a height of 65.0 meters. Find:

a) the time in the air.



Hor	Vert
$v_{ox} = 108.8$	$v_o = 50.7$
$a = 0$	$a = -9.8$
	$d = -65$ ← NOTE! (displacement is down)

→ use vertical info:

$$d = v_o t + \tfrac{1}{2} a t^2$$

$$-65 = 50.7t + \tfrac{1}{2}(-9.8)t^2$$

→ rearrange in quadratic form:

$$\underbrace{4.9}_{a}t^2 \underbrace{- 50.7}_{b}t \underbrace{- 65}_{c} = 0$$

$$t = \frac{-(-50.7) \pm \sqrt{(-50.7)^2 - 4(4.9)(-65)}}{2(4.9)}$$

$= 11.5\text{ s}$ or ~~-1.2 s~~

$$\boxed{t = 11.5\text{ s}}$$

b) the highest height of the projectile <u>above the ground</u>.

→ use vert. info where $v = 0$

$$v^2 = v_0^2 + 2ad$$

$$0 = 50.7^2 + 2(-9.8)d$$

$$\boxed{d = 131 \text{ m}}$$

c) the range.

→ use horizontal info

$$d = v_w t$$

$$= 108.8\,(11.5)$$

$$\boxed{d = 1.25 \times 10^3 \text{ m}}$$

d) the final velocity.

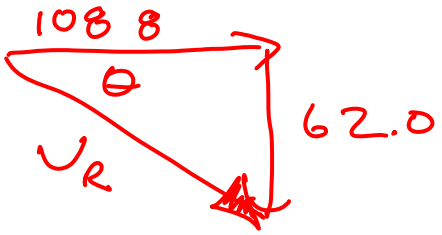
→ horizontal speed = 108.8 m/s

→ vert. info must be calculated:

$$v^2 = v_0^2 + 2ad$$

$$v = \sqrt{50.7^2 + 2(-9.8)(-65)}$$

$$= 62.0 \text{ m/s}$$



$$v_R = \sqrt{(108.8)^2 + (62)^2} = 125.2 \text{ m/s}$$

$$\theta = \tan^{-1}\left[\frac{62}{108.8}\right] = 29.6^\circ$$

so $\boxed{v_R = 125 \text{ m/s} \text{ @ } 30^\circ \text{ down}}$